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OPEN LETTERS.

THE ACTION OF FUNGICIDES.

IN DR. CLARK'S¹ paper, in a recent number of the *BOTANICAL GAZETTE* no attempt was made, as the author states, to discuss the literature of the subject; but Rumm² has written a paper that has such evident bearing on the subject that it should have received attention. The latter reached the following conclusion, based on experimental evidence closely resembling that adduced by Clark as indicating the solvent action on copper hydroxid of secretions or excretions from the cells: "Die Thatsachen, die uns Calcium und Kupferhydroxydmischungen ergeben haben, erklären sich leicht, wenn man annimmt, dass von Beginn der Einwirkung des Kupferhydroxyds an Spuren dieses Stoffes, welche durch aus den Algen austretende Säuren gelöst werden, wenigstens bis in die Wandsysteme der Algen vordringen und den Tod der letzteren bewirken." Rumm, however, failed to obtain the same results with *Puccinia* spores. It thus appears that the only difference between the explanation offered by Rumm and by Clark for the same phenomenon is that the former postulates an acid solvent excretion from the cell, while the latter has shown that saline or other organic substances probably produce the same effects.

Clark also failed to notice a short preliminary paper by the writer³, in which are stated in outline results of investigation covering in substance every phase of the several factors affecting the action of fungicides on foliage which Clark mentions on page 44 of his paper, with the exception of the solvent action of the cell sap on copper hydroxid. The writer gave only part of the experimental data which he had obtained, but enough were given to substantiate the claim made here. A reference to the writer's paper will show the fact established that water must accompany copper hydrate or Bordeaux mixture on peach foliage in order to produce toxic effects.

¹CLARK, JUDSON F.: On the toxic properties of some copper compounds, with special reference to Bordeaux mixture. *BOT. GAZ.* 33: 26-48. 1902.

²RUMM, C.: Zur Kenntniss der Wirkung der Bordeauxbrühe und ihre Bestandteile auf *Spirogyra longata* und die Uredosporen von *Puccinia coronata*. Fünftstück's Beiträge 1: 81-156. 1897. A preliminary announcement of results occurs in *Ber. Deutsch. Bot. Gesells.* 13: 189-192. 1895, and another discussion of same experiments in *Jahresh. Vereins vaterl. Naturk. Württemberg* 54: 322-327. 1898.

³BAIN, SAMUEL M., The injury of fungicides to peach foliage. *Science N. S.* 14: 221, 222. 9 Ag 1901.

The writer also made an experiment on peach leaves quite similar to the one described by Clark, in order to determine whether the leaf gives off any substance having a solvent action on copper hydroxid, and obtained results similar to those obtained by Clark. But these data do not *per se* show the solution of copper hydroxid by leaves in general, because of the presence of gum in the sinuses of the teeth of the leaf in question, apparently secreted by the marginal glands. This gum remains, or is freshly secreted during most of the functional life of the leaf, and must evidently be taken into account in drawing conclusions from the experiment as made by Clark. There can be little doubt, however, that soluble substances escaping from leaves into water on their surfaces will influence the solvent action of this liquid on copper hydroxid. De Saussure found that washing leaves with distilled water removes a considerable proportion of the alkaline salts contained in them, and Gaudichaud and Sachs found that drops of water standing on leaves soon acquire an alkaline reaction towards litmus.

It appears that Barth⁴ was first to propose the theory of the action of fungicides on foliage which was stated by Clark. Droop and Wortmann⁵ are said to have disproved Barth's theory, but the writer has not yet had access to their publications.

In conclusion, the statement may be permitted that the writer does not underrate the importance of Dr. Clark's paper as a contribution to our knowledge of the fungicidal action of the Bordeaux mixture.—SAMUEL M. BAIN, *University of Tennessee, Knoxville*.

REJOINDER.

In regard to the foregoing criticism of the treatment of the literature in my paper, I call attention again to the fact, which Professor Bain recognizes, that no attempt was made "to review the literature of the subject."⁶

In regard to Bain's preliminary paper, I may add that my paper was completed and in the hands of the publishers some weeks before his paper appeared in *Science*. I may also point out that his paper was not concerned with the problem as to how the Bordeaux mixture *effects its mission as a fungicide*—the chief object of my investigation of Bordeaux mixture; and that in regard to the injurious effect frequently observed on the leaves of the host plant, which I discussed incidentally on page 44, I simply brought together those factors which seemed to me to be of importance in this connection, without doing any experimental work except on the solvent action of the cell sap on the copper hydroxid deposited on the leaves. Barth's suggestion has reference to the effect of the mixture on the host plant only.—JUDSON F. CLARK, *Cornell University*.

⁴ Bot. Centralbl. 61: 268, 269. 1895.

⁵ Zeits. Pflanzenkrankh. 10: 165. 1901.

⁶ CLARK, JUDSON F., BOT. GAZ. 33: 26. 1902.